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## TITLE

# MORPHO-FUNCTIONAL SEPTORHINOPLASTY IN ADULT PATIENTS WITH UNILATERAL CLEFT LIP NASAL DEFORMITY - A COMPREHENSIVE APPROACH

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#### Abstract

*Purpose:* The aim of this paper is to introduce a morpho-functional technique of rhinoplasty for correction of defective nasal morphology of the secondary unilateral cleft lip and to improve the passage of air through the nose.

*Method and Material*: The described comprehensive approach follows the rule of 5 'R's, i.e. Relieve, Resect, Reposition, Restructure and Restrengthen. The extended septal graft serves as a columellar strut on one hand and as a spreader graft on the other hand.

*Results:* The morpho-functional septorhinoplasty technique described here is effective for correction of the unilateral cleft lip nasal deformity since it improves the symmetry of the nose, improves the morphology of the alar cartilages and increases the nasal tip projection. There is an improvement in breathing as a result of restored symmetry of ala and nasal vestibule.

*Conclusion:* The morpho-functional septorhinoplasty is a practical tool to handle adult patients with secondary cleft nasal deformities.

#### **KEYWORDS**

Morpho-functional; Cleft rhinoplasty; Extended septal graft

### 1. Introduction

Primary and secondary nasal deformities are commonly associated with congenital cleft lips and their correction requires a focused treatment targeting both morphology and function.

It is an evident fact that a repaired cleft is revealed more by the associated nasal deformities than by the repair line of the lip (1,2). Nasal septal deviation, nasal tip asymmetry and shortening of the columellar length are some of the common problems faced by a surgeon dealing with the correction of unilateral cleft nasal deformities.

Unilateral secondary nasal deformities can show the following features (3) (Figure 01-a,b):

On cleft side:-

- 1. Retro-displaced and less well projected dome.
- 2. Lateral slumping of the medial crus.
- 3. Foreshortened columella.
- 4. Caudal hooding of the lower lateral cartilage (LLC) and alar rim.
- 5. An alar-columellar "web"
- 6. Insufficient vestibular skin in vestibular dome region.
- 7. Altered nostril orientation due to lateralized alar base position and deficient nasal floor volume.
- 8. Displaced alar base (lateral, inferior, and/or posterior).
- 9.. Deviated posterior septum.

On non-cleft side:-

- 1. Deflection of the caudal septum to non-cleft side.
- 2. Maxillary nasal spine deviation to non-cleft side.

The aim of this paper is to present a morpho-functional septorhinoplasty surgical technique which can be used to address nasal deformities associated with unilateral complete cleft lip (with or without cleft alveolus or palate).

#### 2. Method And Material

In the present study, we included 100 non- syndromic patients with unilateral cleft lip and nasal deformity, who underwent secondary cleft rhinoplasty at the GSR Institute in Hyderabad Telangana, India. The patients have not undergone for any nasal correction previously and have had all the surgical procedures from cleft lip repair to jaw correction surgery. The GSR institute is a high-volume cleft and craniofacial center which performs 1200 surgeries per annum; out of that, 200 surgical procedures are performed for secondary nose deformities associated with cleft lip. The local ethics committee approval was obtained for the research protocol in accordance with local government regulations. All participants were provided detailed information regarding the study and signed a written informed consent.

All surgeries for the open morpho-functional septorhinoplasty were performed by the first author under general anesthesia.

#### 2.1 Pre-operative marking and incision

An open rhinoplasty technique is performed to get adequate exposure of the nasal structures. The incision marking is shown in Figure 02-a, b. On the cleft side, a Tajima inverted U flap is marked over the alar cartilage (4). This inverted U is marked on the alar skin that is seen as a semi-circular depression upon lifting the supratip region with fingers up to the height of the required tip projection (Figure 02-a). Next, a point is marked at the base of the medial aspect of the columella. From this point, the medial marginal incision line is extended inferiorly onto the previous cleft lip scar and superiorly to join the Tajima reverse U flap over the alar cartilage (Figure 02-b). The shape, size and continuity with lateral marginal incision of the Tajima reverse U flap are variable depending on any nasal vestibular webbing present on the lateral aspect at the junction of the nasal skin and nasal mucosa. The incision line will cross the webbing and stop at a point where the web fades out. On the non-cleft side, a point is marked at the base of the medial aspect of the columella. The medial marginal incision is extended from this point inferiorly, to join the incision line on the cleft side at a point 5mm inferior to the columella and superiorly, along the junction of the hair bearing and non-hair bearing mucosa internally as in a conventional rhinoplasty. No incision is placed in the columella. A columellar-philtral skin advancement flap is done using a modified V to Y advancement to increase columellar length and revise the cleft lip scar contracture.

#### 2.2 Septoplasty and septal graft harvesting

The nasal septum is isolated by dissecting it from the foot plate of the medial crura. This process begins from the nasal tip and progresses caudally to reach the base of the septal cartilage. The caudal part of the septum is freed antero-posteriorly from septo-nasospinal junction, septo-premaxillary junction and septo-vomerine junction. A well-defined, thick fibrous band is usually

found in the caudal part of the base of the septum, anteriorly, occupying the retro-columellar area. It extends from the curved and deviated part of septal cartilage to the anterior nasal spine (5). These septo-spinal ligaments are completely excised to achieve straighten the septum, centralize columella and achieve nasal sill symmetry. All the abnormal attachments of the septum are relieved and it is repositioned at its morphological site.

A posterior septal cartilage graft is harvested. Care is taken to leave a residual inverted "L"-shaped antero-superior part of the septum that is more than 10 mm in width (*Figure 03-a,b*) to ensure adequate support for the dorsum so as to prevent collapse of the nasal tip and avoid a saddle nose deformity, which can lead to a poor esthetic result, as well as airway obstruction (6).

#### 2.3 Alar cartilage dissection and graft placement

On the cleft side, the alar cartilage is relieved by dissecting away all fibrous tissue attachments around the piriform rim to reposition the alar cartilage along the newly constructed nasal tip. The lateral crus of cleft side is undermined from underlying nasal muco-cutaneous lining and resected to achieve symmetry in length and width of it with comparison to lateral crus on non-cleft side. A soft tissue pocket is created between outer alar and inner nasal skin lining to reposition lower border of lateral crus, which is inferior-caudally displaced in nasal vestibule on cleft side. On the cleft side the upper lateral cartilage is dissected from the nasal septum.

The harvested septal graft is cut into L shape, to be inserted between the medial crura of the alar cartilages on cleft side. This graft acts as an extended columellar strut to strengthen the anterior part of the nasal septum and to maintain tip projection (*Figure 03-c,d*). The septal graft extends in between the medial crura and rests in the septal groove on the maxilla. It also acts like a spreader graft on the cleft side, positioned in between the upper lateral and the septal cartilage (*Figure 04-a*). Thus, with a single septal graft, septal and alar cartilaginous stability and nasal tip projection is achieved.

The extended septal graft is stabilized with 25 gauge straight needles (ROMSONS JUNIORS INDIA) at the desired position which is required to get nasal tip projection and height. It is then sutured with remaining anterior portion of the septum using 5-0 polypropylene sutures (ETHICON, INDIA). A hole is then drilled into the bone on the cleft side to stabilize the extended septal graft anteriocaudally (*Figure 03-d*). It is to be noted that the extended septal graft is not to be stabilized with the anterior nasal spine since the spine is not in the central physiological position. Once it is stabilized, upper lateral cartilages are secured by sandwiching the septal graft with horizontal mattress sutures (Figure 04-a). Intradomal and interdomal sutures are used to define the nasal tip, followed by suturing the lower lateral cartilages to the septal graft with horizontal mattress sutures. Two bilateral alar nasalis muscle sling sutures (*Figure 04-b*) are used to affix the anterocaudal part of the septal graft in position to decrease the flaring of nostrils. This is done by inserting and 18-gauge needle through the skin at the level of alar base groove and exiting through the anterocaudal part of the extended septal graft. A 4-0 polypropylene (ETHICON, INDIA) suture is passed through the aforementioned needle from the anterior base of septum to outside. The needle is then partially retracted without leaving the skin

and is repositioned towards the anterior base of the septum again in central position. Finally, the 18- gauge needle is retrieved leaving the suture in situ. The entire procedure is repeated on the other side. A hole is then created in the anterior nasal spine and the 2 sutures are anchored through it.

Medial crural footplates and septal cartilage are secured together with horizontal mattress sutures (*Figure 04-b*). Additional use of nasal tip grafts like shield, cap and alar grafts or alar strut, batten and margin grafts, is determined according to the unique structural and esthetic requirements of each nasal deformity. In most cases, alar strut (onlay batten) grafts are used reinforce the weakened and deformed alar cartilage on the cleft side. An auricular graft is harvested as it is evident that it is most suitable cartilage graft in the aspect of thickness and shape of it. The onlay batten cartilage graft is applied on restructured original lateral crus of lower lateral cartilage and is extended latero-inferiorly into soft tissue pocket of alar base (*Figure 05*). Thereby, the repositioned and restructured lower lateral cartilage on the cleft side is restrengthened by following the rule of "5-R". These grafts are stabilized by using 5-0 polypropylene sutures. This completes the reconstruction of the cartilaginous tripod of the nose (*Figure 04-b*).

#### 2.4 Closure

The skin envelope is draped such that the desired columellar height is achieved passively. The Tajima reverse U flap is rotated inward and sutured with 5-0 polypropylene sutures to correct the nasal web and the nasal soft triangle. The columellar-philtral skin advancement flap is then sutured in position, with a modified V-Y plasty technique to increase the columellar height (*Figure-06, A-D*). Quilt suturing starts from the antero-caudal area of septal cartilage, progressing towards nasal tip, after which it advances posteriorly to cover the whole cartilaginous nasal septum. This is done to minimize dead space in the sub-perichondral plane on either side of the septum.

#### 3. Results

A total of 100 patients (38 females and 62 males) whose age ranged from 17 to 21 years old, underwent secondary cleft rhinoplasty. The patients were followed by the operating surgeon for one year (*Figure 07, 08*). Patients were asked about esthetic and functional improvements. Patients reported a subjective improvement in their breathing patterns and an absence of any breathing difficulty. Revision was required for three patients due to minor asymmetries. Five of the patients showed drooping of lower lateral cartilage on cleft side which was treated with batten onlay grafting.

#### 4. Discussion

The cleft rhinoplasty possesses dogmatic views regarding the time of surgery, surgical approach, and use of grafts.

Gillies and Millard, in 1966, held the correction of nose with primary lip repair to be unreasonable due to the inevitable need for secondary correction (7).

Though most cleft surgeons do attempt some form of nasal deformity correction during primary lip repair, it does not eliminate the need for secondary repair at a later age.

Bardach and Cutting posited the nasal deformity to result from a combination of underlying factors, such as imbalanced musculature and hypoplastic or asymmetric skeletal base in the facial region(8). A number of techniques have been described for definitive correction of complex, multi-faceted problems associated with the unilateral cleft lip nasal deformity (4,9,10,11,12,13,14).

In submental view, cleft noses are seen to have an ellipsoid appearance with a deep nasal root and an underrotated and rounded tip. Thick sebaceous skin and weak lower lateral cartilages contribute further to an appearance of blunted nasal contours(15,16). The basis of our morpho-functional approach is the rule of 5 R's (Relieve, Resect, Reposition, Restructure and Restrengthen) to treat patients with unilateral cleft nose deformity.

The first step in combined septorhinoplasty is septal correction with adjustment of the anterior nasal spine as the septum underpins the nasal esthetics as well as unhindered breathing. This aspect of cleft rhinoplasty has received barely any attention in prevailing literature with scant descriptions of septal defects and their pathogenesis. The septum in cleft noses often deviates at three levels (17) and needs to be corrected in toto. Therefore, a straight nasal septum with the required tip height should be reconstructed and repositioned to form a straight nose (18) which also contributes to the midline symmetry of face. This was achieved by following relieve, resect and reposition steps of the principle of 5 R's. The repositioned cartilages are vulnerable to deformation or displacement in the post-operative period due to the various forces generated from the tissues in healing process. These may be the intrinsic forces resulting from the property of cartilage memory or the stress caused by the healing soft tissue envelope and the asymmetric muscle pulls. Hence, the septum needs to be restructured and restrengthened either by using an extended septal graft or auricular cartilage graft. The ease of harvest of both septal and auricular grafts make them good choices for reconstruction and septal stabilization in cleft rhinoplasty. The versatility, convenience and availability of sufficient quantity and quality of graft with little extra effort, makes the septal cartilage graft, the most popular option for a primary rhinoplasty. The harvested septal/tragal grafts can be used as columellar strut, alar batten graft, as well as spreader graft. Crushed septal cartilage is a good option to achieve volume and soften the transition zones for the tip.

In cases where inadequate septal cartilage was present, an auricular or tragal cartilage was used. Its primary drawback is the inherent curvature and elasticity, which requires stacking and suturing of the graft to achieve the desired contour, strength and volume. How the columellar strut should be used is determined by the deficiency in the projection of the nasal tip and the structural integrity of the lower lateral cartilage. (19). A long fixed strut is generally advised in treatment of unilateral cleft lip nasal defects.

Another common problem in cleft patients is the introverted lower lateral cartilage causing obstruction of the external nasal valve. A thickened and hooded ala results from posterior-inferior introversion of the cephalic edge of lower lateral cartilage into the vestibule. A vestibular webbing can also be seen through the cleft side nares due to the lateral nasal sidewall attachment on the depressed cleft side piriform rim. That is why, the deformed lower lateral cartilage is relieved from the all the abnormal attachment with facial musculature and piriform rim and repositioned with reconstructed nasal tip, thus the required tip projection is achieved.

Nasal tip projection and nasal tip definition are the most challenging aspects of rhinoplasty to perfect.

There are three major tip support mechanisms

- 1. Shape, size and strength of lower lateral cartilages
- 2. Medial crural attachment to the caudal part of septum
- 3. Attachment between lower lateral and upper lateral cartilages

The minor tip support mechanisms are

- 1. Interdomal ligamentous sling
- 2. Sesamoid complex extending the support of the lateral crura to the piriform aperture
- 3. Attachment between the alar cartilages and overlying skin
- 4. Cartilaginous septal dorsum
- 5. Nasal spine
- 6. Membranous septum (20)

All or many of the above mentioned mechanisms are deformed in the patients with cleft nasal deformity.

The positions of tip defining points and their alterations are assessed based on the tripod of nasal base. (21) The 'M'-arch model is seen as an expansion of the utility of the tripod concept with slight departure from its simplicity. It considers entire length of the cartilaginous arch, a relevant determinant for nasal tip parameters. This allows a surgeon, to more reliably and creatively control the tip projection, rotation and refinement using various suturing, grafting and cartilage cutting techniques at any point along the arches. (22)

Graft positioned between the alar cartilages acts as an extended columellar strut, strengthening the anterior part of the septum, providing tip support and projection while correcting the buckled

and mal-positioned alar cartilages. The repositioned lower lateral cartilage has the increased height of medial crus and strengthened lateral crus using battening graft. Thus, the 'M' arch of nasal base is restructured. Intradomal and interdomal sutures are the best option to preserve tip rotation and achieve tip refinement.

A major stigma of the cleft nose is due to the nasal base asymmetry resulting from the horizontally widened nostril on the affected side. (23) A number of techniques have been described for creating symmetrical nasal vestibules and alar base by lifting the sunken ala in the contemporary literature (10, 17, 24). All the mentioned studies have focused on the lateralized alar cartilages but not on the muscle pull which causes its lateralization. In the present study, two bilateral alar nasalis muscle sling sutures are used to fix the antero-caudal part of septal graft in position. The medial crural footplates are secured to septal cartilage; thus a good ala base symmetry is achieved (*Figure 04-b*).

Short columella and decreased columella show on the cleft side is another issue while treating a cleft nose deformity. The incision used in the study is a modified extended Tajima incision where a columellar-philtral skin advancement flap is created using a modified V to Y advancement to increase columellar length and revise the cleft lip scar contracture (*Figure 04 b*, 06). The extended septal graft has acted as columellar strut improving the nasolabial angle, nasal projection, columellar show, and the structural integrity of the tip.

The accentuated soft triangles of the ala which has been neglected usually has been given importance in the presented technique and corrected by rotating the Tajima reverse U flap inwards and suturing it to correct nasal web and nasal soft triangle. Thus, the rule of 5R's is accomplished in this technique. In our technique, we have addressed all the structural and functional problems associated with adult cleft rhinoplasty through prudent compilation of other techniques to provide the best achievable outcome to the patient and ultimately a morphofunctional equilibrium.

Outcomes in this study were assessed based on subjective assessment. So, the reported asymmetries were based on subjective visual comparison of shape and size of the alar dome and base on non-cleft versus cleft side. The evident discrepancies were corrected by alar base reduction and alar dome shaping with onlay alar batten graft. Long onlay alar batten cartilage graft using auricular cartilage is our preferred option as the inherently curved shape and its thickness make it ideally suited to restoring the shape of the alar domes. This graft overlies the lower lateral cartilage and is extended laterally into soft tissue pocket at the alar base.

Considering the nature of the surgical site and the procedure itself, despite following all precautions and techniques, absolute stability of the results cannot be predicted because of the process of scarring and variations in laxity of tissue. We could not find a single research paper documenting the rate or incidence of sequelae of secondary cleft rhinoplasty unlike primary cleft lip and palate surgical techniques. In this study, five patients came back with drooping of lower lateral cartilages, which was surmised to be the result of excessive scarring and resulted in narrowing and collapse of the nasal dome. These were resolved using 'Z-plasty'' for skin tissue

with insertion of additional onlay alar batten cartilage graft for strengthening the underlying structure.

Secondary or definitive cleft rhinoplasty is the "ultimate" surgery for cleft nose deformity, and its outcomes and technical challenges correlate to a variety of factors ranging from the previous interventions to experience of surgeon. The basic principles of cleft rhinoplasty apply in revision surgeries, primary and secondary cleft rhinoplasty alike. What remains important is to recognize and anticipate asymmetries and onset of scarring that may affect the functional and esthetic outcomes. Early recognition may allow for touch-up work to prevent more extensive and disfiguring scarring sets in; but, it is of paramount importance to individualize the assessment and treatment of these patients.

Another common sequela is notching in soft tissue triangle as a consequence of the Tajima incision. This can be minimized by paying close attention to the anatomic boundaries for proper placement of incision (without involving external alar rim skin) and maintaining adequate support of alar cartilage during rotation of skin flap. This notch also tends to improve over time as laxity of skin improves with progression of healing process. Also, as it is not very evident in frontal view, patient compliance is not usually major concern.

It appears self-evident that both esthetic and functional improvements of the cleft nose are important goals that must be achieved with regularity, but is still a challenge to achieve predictably. This study highlights the necessity of taking into consideration, both the esthetic and functional aspects when planning or assessing the long-term effects of surgery. In the present study, we were able to achieve not only the esthetic but also functional goals by using this surgical technique.

This morpho-functional open septorhinoplasty technique requires a long-term esthetic evaluation such as 2-D, 3-D photographic assessment and functional volumetric evaluation so it can be standardized as a surgical procedure for reconstruction of unilateral cleft nasal deformity.

#### 5. Conclusion

The repair of cleft associated nasal deformities is among the most challenging aspects of cleft management. The described morpho-functional septorhinoplasty approach shows promise as a comprehensive treatment procedure for correction of secondary nasal deformities in adult patients. We tried to include all corrective aspects of nose while according appropriate importance to inherent muscle pulls. Use of the cartilage autografts provides improved structural reinforcement, thus facilitating better tip definition and supplementing the resistance to wound contracture and collapse. This technique can be applied in bilateral cleft noses also by slight modification in skin incision for the columellar lengthening by making it more centered and extended towards the philtrum. The technique can also be used in Caucasian population by using the principles for thin skin in alar battening and tip grafting.

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## 7. Figures legends

*Figure 01.* (Left to right-a, b) Unilateral cleft lip-nose deformities in Worm's eye and frontal view

Figure 02. (Left to right-a, b) The incision marking

*Figure 03. (upper row to clockwise-a, b)* Harvesting the septal cartilage ; ( c,d) carving out and placement of Extended septal graft

*Figure 04.* (left to right-a, b) sandwiching the septal graft between upper and lower lateral cartilages on cleft side; Sling suture through bilateral Alar-nasalis muscles and base of extended septal graft

Figure 05. Placement of onlay batten cartilage graft on lateral crus on cleft side

*Figure 06. (upper row to clockwise a, b, c, d)* Pre-, intra- and immediate post- operative photos of Morpho-functional septorhinoplasty for unliteral cleft lip nose deformities

Figure 07. Patient's pre- and post-operative (6 months follow-up) photos

Figure 08. Patient's pre- and post-operative (6 months follow-up) photos

## 8. Ethical approval

Not required.

## 9. Funding

None.

## **10.** Competing interests

None declared.

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